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(54) Catheter with independent proximal and distal control and actuator for use with same

(57) A steerable electrocardial catheter comprises an elongated flexible shaft and a flexible tip assembly connected to the distal end of the shaft. The tip assembly comprises a distal section and a proximal section coaxial with the shaft, the stiffness and length of the distal and proximal sections being selected to provide a predetermined curve configuration of the tip assembly when the distal section and/or proximal section is bent. A first pair of pull cables extending through the catheter is anchored at a first point in the tip assembly for bending the proximal section in a predetermined plane. A second pair of pull cables extending through the catheter is anchored at a second point in the tip assembly for bending the distal section in a predetermined plane. Any desired orientation of the bending planes is possible with the invention. A handle/actuator for use with a steerable catheter having a tip assembly and four pull cables for bending said tip assembly, comprises a housing containing rotary and linear actuators. The rotary actuator is in the form of a wheel rotatably supported in said housing with a portion of said wheel being accessible from the exterior of said housing. Two of the pull cables are anchored to the wheel such that clockwise rotation of the wheel applies tension to one pull cable and counter-clockwise rotation of the wheel applies tension to the second pull cable. The linear actuator comprises a slider mounted in said housing and means

exterior of the housing for moving the slider linearly. The third and fourth pull cables are anchored to the slider such that linear movement of the slider in one direction applies tension to the third cable and linear movement of the slider in the opposite direction applies tension to the fourth cable.

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	US 4 873 965 A (DANIELI)	1-8, 10-13	A61M25/01 A61B1/00
Y	* column 2, line 22 - column 3, line 20; figures 1-5 *	14-17	
Y	US 5 125 896 A (HOJEIBANE) * abstract; figure 1 *	14-17	
P,X	EP 0 521 595 A (LUNDQUIST)	1-8, 10-17	
P,A	* column 24, line 42 - column 33, line 10; figures 35-46 *	19-24, 26,28	
P,A	US 5 179 935 A (MIYAGI) * column 3, line 34 - column 6, line 20; figures *	1,3,7,14	
A	WO 91 11213 A (EP TECHNOLOGIES) * abstract; figures 6-24 *	19,21, 24,28	
A	US 3 552 384 A (PIERIE) * column 3, line 11 - column 4, line 27; figures 3,4 *	19,21, 24,28	
A	GB 2 138 687 A (WARNER) * page 2, line 25 - line 61; figure 5 *	19,21, 24,28	
A	US 4 586 923 A (GOULD) * abstract; figures *	19,21, 24,28	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.) A61M A61B
Place of search	Date of completion of the search	Examiner	
THE HAGUE	9 December 1996	Kousouretas, I	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims

- All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and those claims for which fees have been namely claims:
- No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of the unity of the invention and relates to several inventions or groups of inventions, namely:

see sheet B

- All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims
- Only part of the further claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respects of which search fees have been paid, namely claims:
- None of the further claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-18: A steerable catheter with two sections and pull cables
2. Claims 19-28: A steerable catheter having a handle with a housing, a wheel and a slider